

# Whole System Protection A New Approach to Shelf Life Extensions

**11th Annual Government Industry Shelf-  
Corrosion Life Symposium Static  
Intercept®**

24 - 26 August, 2004

# Who Are We

- The Intercept Technology™ was developed by Lucent Technologies Bell Labs
- The Intercept Technology Group (ITG) was established to provide worldwide marketing and sales for the Intercept based products

# Systems Approach

- Shipping a phone switch to Asia entails shipping not only sheet metal, but electronics, plastic components, gaskets and potentially optical devices and lasers
- Packaging schemes are normally designed to:
  - Keep metal from rusting / corroding / tarnishing
  - Keep systems structurally safe
  - Provide cushioning and physical protection
- What about the other components in the system?

# Corrosion as a Shelf Life Issue

- Corrosion can be a **chemical reaction** between a metal and a reactive, or unstable gas or liquid
- Corrosion can be an **electrical reaction** between dissimilar metals
- Corrosion can be an **electro-chemical reaction** between dust and a metal surface
- Corrosion can be caused by **biological action**, such as by sulfur producing molds and bacteria
- The discussion can also be expanded into **surface changes** to non-metallic materials as well – such as wood, cloth, plastics, paper, rubber, elastomeric compounds, etc. all of which are affected adversely by atmospheric pollution

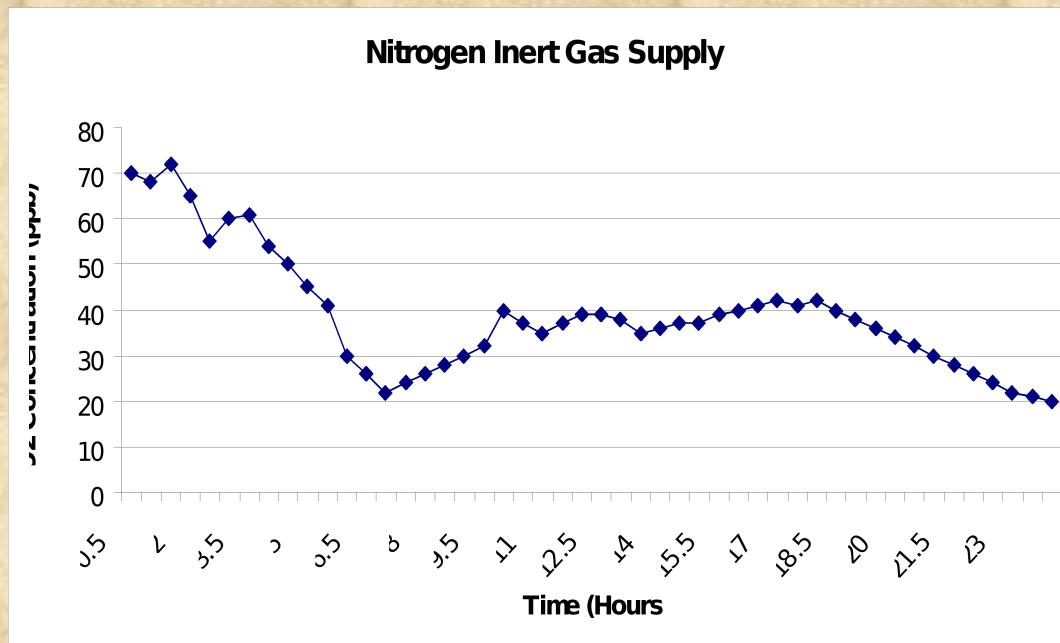
# Protection with Inert Gases

- Materials sensitive to degradation in normal atmospheric environments have been stored in protective environments comprised of inert gases. Helium (He), Neon (Ne), Argon (Ar), Krypton (Kr), and Xenon (Xe). The problem is expense.
- Nitrogen comprises 78% of the earth's atmospheric gases. It is plentiful, but nitrogen is not an inert gas and does react with other gases, but it needs a driving force to do that. Given the forces needed to cause a reaction to take place with Nitrogen it was found that if the nitrogen was dried out (water removed) the resulting gas was fairly inert.

# N2 is Very Clean - But Very Clean May not be Clean

## Enough

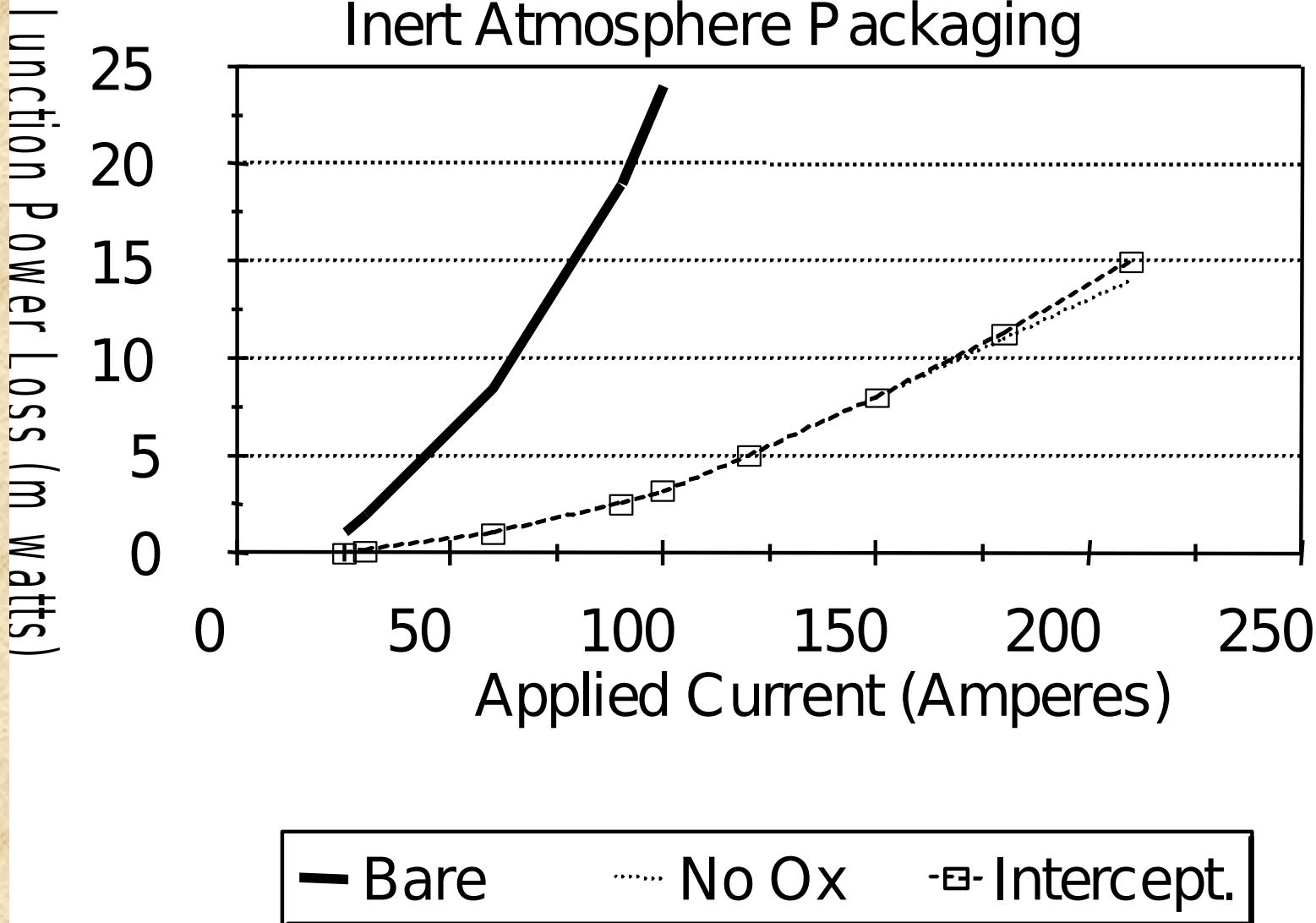
The Nitrogen gas boil off from in-house liquid nitrogen supply line was analyzed for Sulfur Dioxide (SO<sub>2</sub>) over a 24 hour period



As you can see in the graph above the corrosive SO<sub>2</sub> can show up in your inert gas with concentrations ranging from 30 to 70 ppb. That is a considerable amount of corrosive gas.

# Contact Protection

Effectiveness of Intercept as Replacement for  
Inert Atmosphere Packaging



# Atmospheric Pollution

- Ozone (**O<sub>3</sub>**) - reactive oxygen
  - Accelerates degradation of materials in conjunction with other reactive gases / also affects rubber, paper and plastic
- Hydrogen Sulfide (**H<sub>2</sub>S**) and Sulfur Dioxide (**SO<sub>2</sub>**)
  - Effluent from pulp mills, oil refineries, heavy industry, fossil fuel combustion and decaying vegetation, breakdown of vulcanized rubber, breakdown of paper
- Carbonyl Sulfide (**COS**)
  - From fossil fuel combustion, wood fires and ocean surfaces
- Nitrous Compounds (**NO<sub>x</sub>**)

# Factors in Shelf Life Aging

- Oxygen (O<sub>2</sub>)
- Corrosive Gases (Atmospheric Pollution)
- Light
- Heat
- Humidity
- Oils
- Solvents
- **Biologicals**
- Particulates
- Electrostatic Discharge (ESD) for electronics

# Sulfur / Corrosion Issues

- Average level of **H2S in the US**
  - **7 ppb** (parts per billion)
- Average level of **H2S in Shanghai**
  - **800 ppb** (parts per billion)
- Average level of **H2S in a typical plant in Shanghai and Souzhou**
  - **1.5 ppm** (parts per million)
- H2S is the most aggressive form of Sulfur, its no wonder that we are seeing more corrosion issues with products manufactured in China - the higher the concentration, the faster the rate of corrosion

Testing courtesy of Bell Labs - 2003

Bell Labs developed Intercept Technology to provide:

- **Elimination of corrosive gases that shorten shelf-life**
- **Long-term corrosion protection**
- **Works on both Ferrous and Non-Ferrous Metals**
- **Permanent ESD electronics protection**
- **Ultra-clean “clean room” packaging**
  - **No or limited outgassing, Non-Volatile Reside (NVR), low ionic contamination**
- **Passive biological inhibition (anti-mold/mildew)**
- **Safe to handle/use packaging**
- **Safe for all equipment**
- **Recyclable (colored PE), environmentally friendly**

# How Does Intercept Work?

- Bell Labs determined a way to transform normal plastic into a high gas barrier material utilizing Copper reacted into the plastic chain
  - Reacts with and permanently neutralizes corrosive gases
  - Seals and forms like a standard plastic
  - Extremely long lasting
  - Does not coat / contaminate / leave deposits of any kind
  - Safe for all products - NASA Approved

# Case Study #1 - Analogic

- Analogic Corporation is a recognized worldwide as a leading custom designer and manufacturer of innovative, complex, high-performance, advanced systems and subsystems sold primarily to Original Equipment Manufacturers (OEMs).
- Their customers are typically major medical, industrial, and telecommunications companies, many of which are Fortune Global 500

# **Situation: Need Robust, easy-to-use Packaging providing Protection against Harsh Environments**

- While trying to meet the worldwide demands for their sensitive, large scanners and imaging equipment, Analogic needed a packaging material that not only would give them the proper protection, but would also offer them an easy application that wouldn't tie up their labor and slow down production.

# **Solution: A Barrier Packaging Solution that Would**

- Give adequate protection for the toughest worldwide environments
- Continue to work in harsh environments even with punctures, slits and/or slices
- Be quick and easy to put in place
- Offer long-term, even years, if necessary, protection.

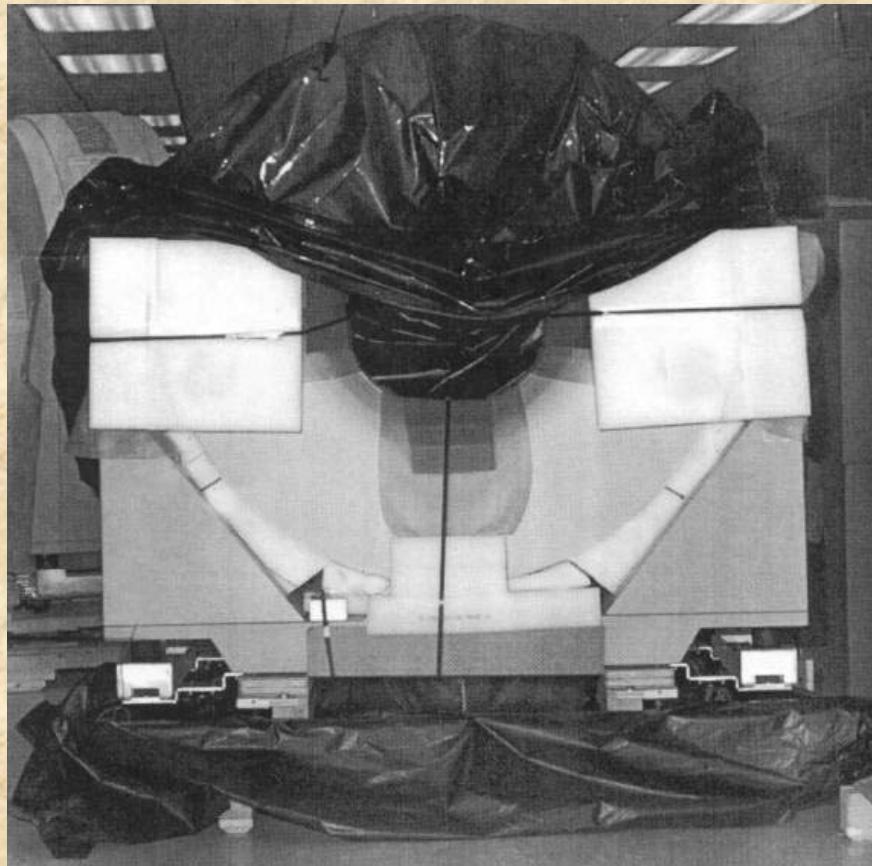
# **Static Intercept™ “Quick Pack” Shrouds: Robust, Easy to Apply, Cost Effective**

- Static Intercept "Quick Pack" Shroud system solved all of Analogic's packaging problems.
- No heat-sealing or vacuuming, the Static Intercept 3 mil bottom sheet and 4 mil custom build shroud can be applied in just 7 minutes.
- With Static Intercept's preferential corrosion protection, the material will continue to offer some protection, even if the barrier is punctured or torn.
- Equipment would be safe from atmospheric attacks in shipment, as well as in storage for long periods of time, and under varied environmental conditions.

# Results: No, Zero, Returns since Implementation

- Since implementing “0” returns due to corrosion in transit or in storage.
- Packaging workers are able to keep pace with production.
- The production force is now able to put their efforts into building new items, instead of repairing damaged ones.
- Management can have peace of mind that their equipment is safe when shipping to the harsh environments and storage conditions because Static Intercept provides that kind of assurance.
- Production schedules don’t have to be built to keep the product fresh, because when stored in Static Intercept, the equipment will not degrade due to corrosion.

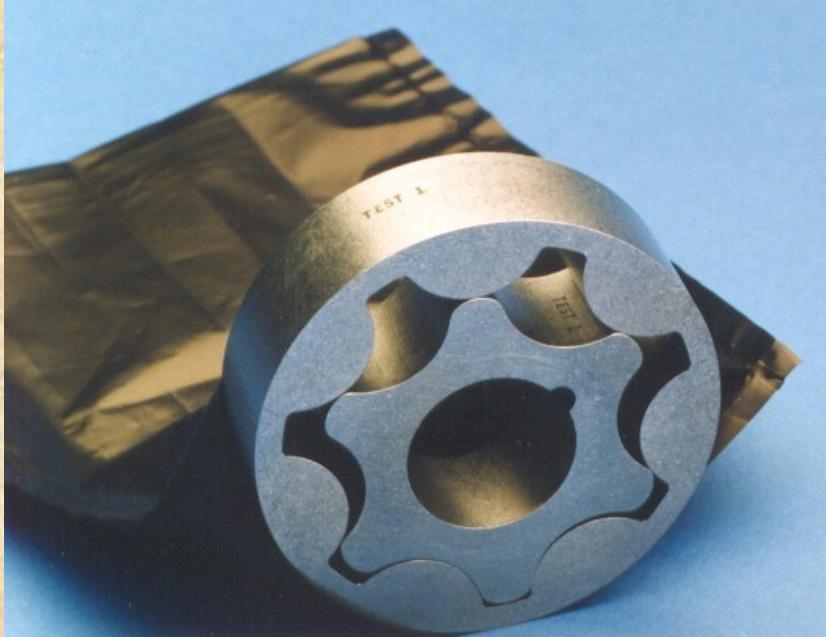
# Example of the Analogic Pack



# **Case Study #2- Nichols Airborne Division of Parker Hannifin Corporation**

- **Situation: Critical Pump Part Susceptible to Corrosion**
- **Problem: Worker Safety, Productivity & Operational Costs**
  - To minimize corrosion, Nichols used MIL-B-131 barrier bags, requiring a nine-step, machine-based process involving heat sealing. This approach – especially in the company's older facility where ventilation was inadequate (1997) – affected worker safety and productivity.

# 60,000 Parts Packed – 0 Rejections



## **Static Intercept Bags: Safe, Reliable, Reusable, Cost Effective**

Static Intercept zipper-style bags solved all the problems. Without the need of heat-sealing or packing station equipment and a three-step packaging process, worker safety is no longer at risk and the process is easier – ensuring higher levels of productivity. If the gerotor part must be put into storage, requiring corrosion inspection after being picked to ship, the inspection can be performed without violating the integrity of the barrier package. In short, the bag doesn't need to be reheated and resealed.

# Case Study 3 - Solderability



## *Summary*

- The control samples became corroded upon exposure as expected (Figures 3 through 7).
- The coupons sealed in the Intercept<sup>®</sup> bags showed less corrosion than those coupons sealed in Brand X bags upon Salt Fog exposure (Figures 8 through 27).
- The coupons protected by the Intercept<sup>®</sup> bags wetted further with solder than those protected by Brand X bags (Figures 33 through 52).

## Test Methods:

Thirty silver plated copper coupons were obtained and sectioned from the support panel which they were attached to. The coupons were identified with a number and examined for scratches or anomalies in the plating surface prior to salt fog exposure (See Figures 1 and 2).

### *Salt Fog Exposure*

Ten coupons were sealed in Brand X static shielding bags and ten sealed in Intercept® anti-corrosion ESD bags. An Audion Electro Sealmaster 580-A bag sealer from West Coast Plastic Co was used and it was noted that for Brand X bags setting four gave the best seal while setting six worked best with the Intercept® bags. The twenty sealed bags along with five control coupons (unsealed) were inter dispersed through out the Harshaw model 300 Salt Fog chamber and exposed to seven consecutive days of salt fog per ACI procedure AP0210-1. At the end of the environmental stressing the bags were opened and the coupons examined visually for qualitative analysis of the corrosion if any present on the coupons (See Figures 3 through 27).

### *Prescreening*



Figure 1 bare coupon prior to salt fog.



Figure 2 bare coupon prior to salt fog.

*Post Salt Fog exposure*

Control samples left exposed



Figure 3 Coupon #36.



Figure 4 Coupon #37.



Figure 5 Coupon #38.



Figure 6 Coupon #39.

Samples sealed in Intercept® bags



Figure 8 Coupon #1.



Figure 9 Coupon #2.

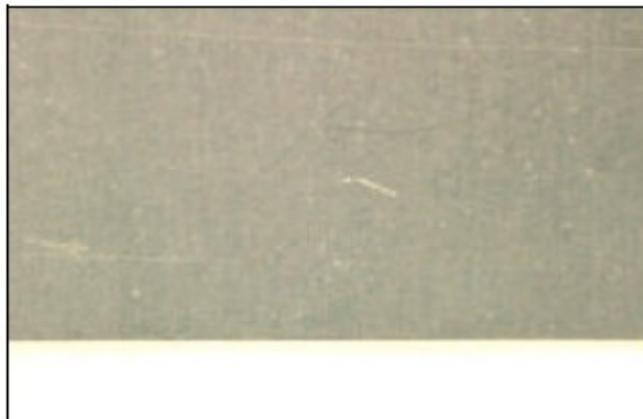


Figure 10 Coupon #3.



Figure 11 Coupon #4.

Samples sealed in Brand X bags

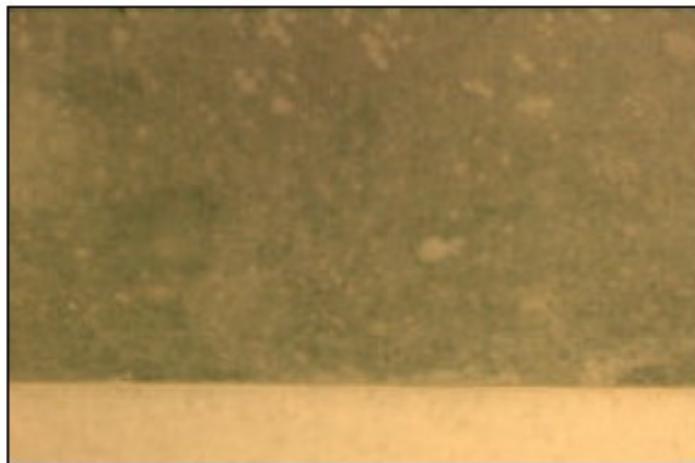


Figure 18 Coupon #16.



Figure 19 Coupon #17.



Figure 22 Coupon #20.



Figure 23 Coupon #21.

*Post Soldering*

Control samples left exposed



Figure 28 Coupon #36.



Figure 29 Coupon #37.



Figure 30 Coupon #38.



Figure 31 Coupon #39.

Samples sealed in Intercept® bags

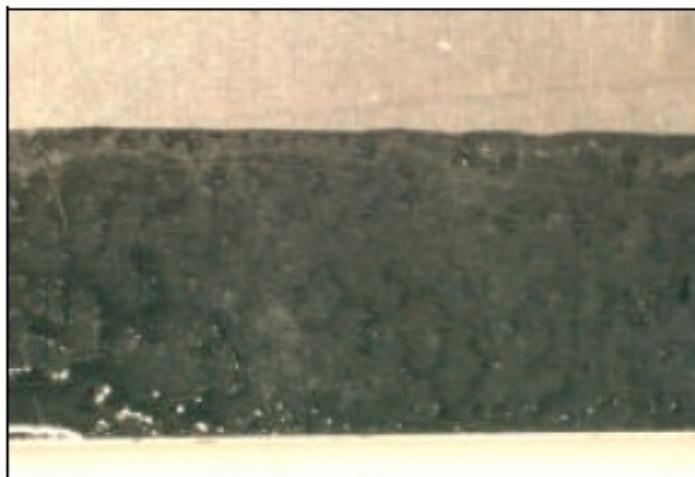


Figure 33 Coupon #1.



Figure 34 Coupon #2.

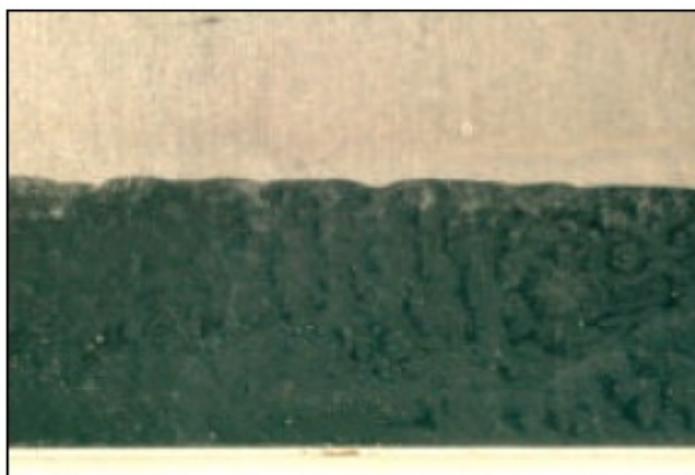


Figure 35 Coupon #3.



Figure 36 Coupon #4.

Samples sealed in Brand X bags



Figure 43 Coupon #16.



Figure 44 Coupon #17.



Figure 45 Coupon #18.



Figure 46 Coupon #19.

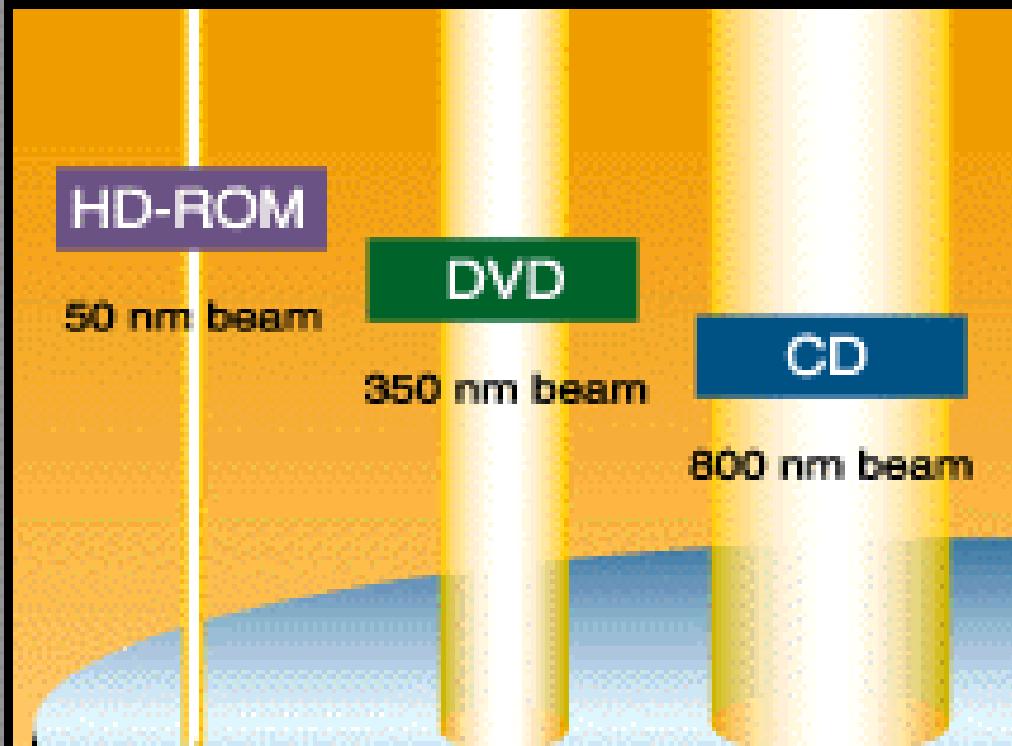
# Case Study 4 – Digital Data Protection

- CD's are damaged by the reaction of the environment and environmental conditions on the sensitive Aluminum, or reflective layer
- To Protect CD's you must:
  - Understand what causes the damage
  - Protect them against what causes the damage
  - Design a system to make this protection easy

New  
Technology  
Demands  
Even  
Better Protection

Intercept can  
Protect even the  
Most demanding  
application

## Comparative Beam Sizes



**165**  
Gigabytes  
per disc

**4.7**  
Gigabytes  
per disc

**.65**  
Gigabytes  
per disc

nm = nanometer

Beam sizes not to scale

# Digital Data Shelf Life Protection

- Digital Data - CD's, CDR, CDW, DVD - are all affected by environmental factors
  - **Ozone** -active oxygen oxidizes the AL layer
  - **Corrosive Gases** - corrode metallic layer
  - **UV Light** - UV light can degrade the protective topcoat layer of the digital disc
  - **ESD** - testing at Lucent has shown that with as little as 2800 volts damage can occur but at 12,700 volts the AL layer will be damaged
  - **Fungal / Mould** growth affecting topcoat
  - **EFFECT** - 20Mb data loss replacement est. \$64,400 (US National Security Association)

# CD Breakdown Process

- Extensive research by Bell Labs, Engineered Materials, and Omega Intercept, among others, has determined that Ozone and reactive Oxygen are leading causes of Aluminum layer breakdown
  - When Aluminum, in thin a film, oxidizes it becomes clear and unable to reflect the laser pulse attempting

# ESD Damage

- Direct ESD discharge to digital data storage systems (CD's / CDR / DVD) can result in premature failure
- Extensive research by Bell Labs, measuring actual voltage required to break down the protective top coat and vaporize or oxidize the inner AL layer
  - Robust CD's can be permanently damaged by a direct discharge of 12,500 volts
    - People cannot sense less than 5000 to 10,000 volts
    - You can generate up to 20,000 volts by simply walking across a carpet, pick up 12,000 to 15,000 volts by touching a metal door handle

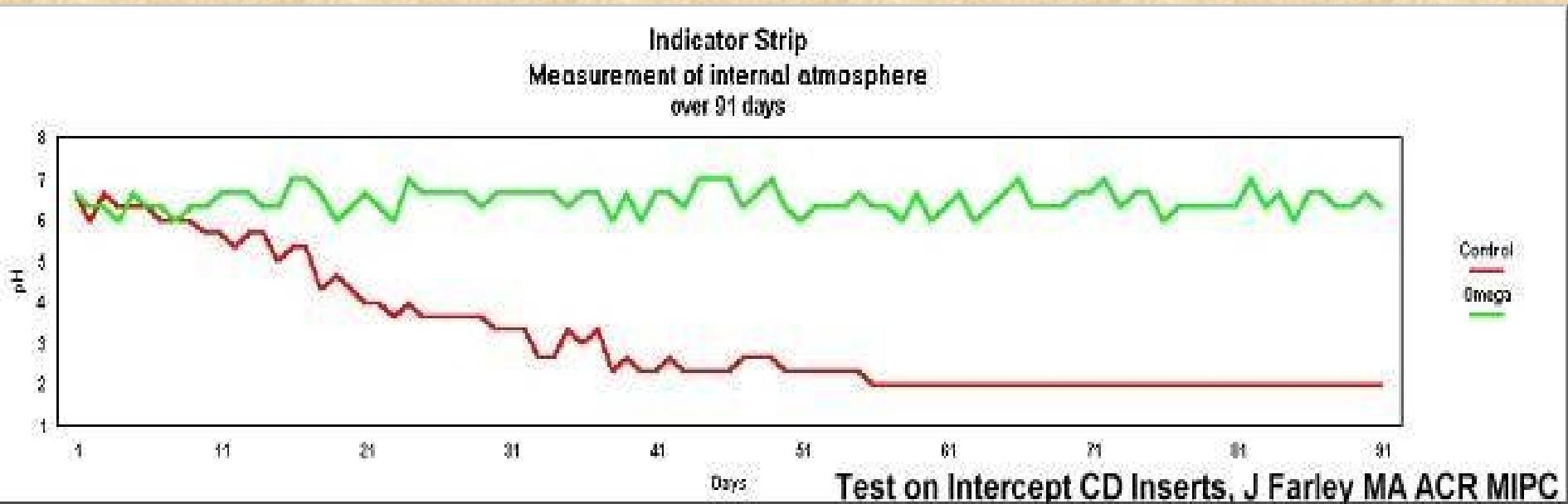
# Sulfur dioxide (SO<sub>2</sub>)

- Sulfur consuming bacteria, thiobacillus thioparus being one example, converts atmospheric SO<sub>2</sub> to sulfuric acid, which it uses as a digestive fluid.
- SO<sub>2</sub> and particles of charcoal (soot) produced corrosion much more rapidly than SO<sub>2</sub> and moisture alone because carbon adsorbs SO<sub>2</sub> and creates SO<sub>2</sub> concentration
- Intercept stops this process - not allowing the bacteria to grow or flourish, plus reacting and neutralizing the SO<sub>2</sub> formed

# Biological Attacks

- White mold / mildew can attack the top coat, breaking it down allowing for the aluminum layer to be attacked and damaged
- Tested extensively by EMI records
  - Intercept passed
    - Intercept does not actively kill mold / mildew, but the Copper in Intercept acts as a passive mildewcide ensuring mold and mildew cannot grow

Below is a graph of some of the results From testing by Jon Farley – the green Line was the Intercept CD Insert The red line – standard CD Insert



The build-up of acid helped attack the top coat  
Making the Aluminum layer vulnerable

# EMI Music

- 18-month test on Intercept (inserts & bags) to protect CDs from data loss, delamination, corrosion (original test planned for only 1 month)
- Results: Excellent
  - Intercept was the only protection method for CD's / DVD's that provided extended protection
  - Intercept provided stable, long term protection with

# Intercept Protection

- Intercept reacts with and permanently neutralizes Ozone and reactive Oxygen
- Intercept provides ESD protection
- Intercept provides passive protection from mold and mildew (a leading cause of degradation in Asia)
- Intercept protects against UV radiation
- Intercept is the solution to CD breakdown and safe storage

# CD Protection Storage System

- Intercept Inserts for jewel cases - provide long term protection



- Other Intercept CD Products
  - Boxes / Envelopes
  - CD Sleeves
    - Polyester - 1 CD
  - CD Pages
    - 4 / 8 CD's per page
    - Single and double
    - 8.5" x 11"
    - A4 sizes also available

# Intercept is Safe & Flexible

## Intercept configurations

- ✓ Intercept Shrinkfilm
- ✓ Handmade Shrouds
- ✓ Bags of all Sorts of sizes, dimensions, closures, laminations, reusability
- ✓ Thermoforming
- ✓ Rolls & Wraps (including conforming stretch)
- ✓ Use your **Imagination**

# Where Can It Be Used?

- Subzero to tropical **temperature** extremes
- 0-100 percent **humidity**.
- Extreme **Ultraviolet** Exposure (w/SCS)
- High **Wind** Exposure (w/SCS)
- To augment **existing packaging**
- On **any** piece of equipment
- Field, Ship, Base, and OEM

# **Intercept Technology Products**

- Film and Bags - Flat and Reusable Zipper Closure
- RIBS - Cleanroom and Shielding Bags
- Moisture Barrier Bags - SIF 2000
- Export Bags - Large Bags for export shipments
- Cushion Bags, Pouches and Rolls
- PP Plastic Corrugate - Boxes and Sheet
- Extrusion coated paper and fabric
- Intercept Foam - die cuts, sheets, cores
- Intercept Shrinkfilm (small to large projects)
- Intercept Re-Usable Covers (All plastic & laminates)
- Intercept Stretch Film

**Learn more at:**

- [www.InterceptShrinkfilm.com](http://www.InterceptShrinkfilm.com)
- [www.StaticIntercept.com](http://www.StaticIntercept.com)
- [www.Omega-Intercept.com](http://www.Omega-Intercept.com)
- [www.LibertyPackaging.com](http://www.LibertyPackaging.com)



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